

## CLAIMS

1. A lithographic projection apparatus comprising:
  - a radiation system to supply a projection beam of radiation;
  - 5 a support structure which supports a beam patterning structure, the beam patterning structure serving to pattern the projection beam according to a desired pattern;
  - a substrate table to hold a substrate; and
  - 10 a projection system that projects the patterned beam onto a target portion of the substrate;
  - a level sensor that measures at least one of a perpendicular position and tilt about at least one parallel axis of a surface of an object held by one of the support structure and the substrate table, said level sensor generating a position signal indicative thereof, perpendicular referring to a direction substantially perpendicular to the said surface and parallel referring to a direction substantially parallel to said surface;
  - 15 a servo system responsive to said position signal for moving said object to a desired position; and
  - a filter disposed between said level sensor and said servo system for filtering said position signal.
- 20 2. Apparatus according to claim 1, wherein the filtered position signal forms a setpoint for said servo system.
- 25 3. Apparatus according to claim 2, wherein said filter is a low-pass filter arranged to pass components of said position signal having a spatial frequency lower than a predetermined spatial frequency.
4. Apparatus according to claim 3, wherein at least one of the support structure and the substrate table are moveable to effect a scanning exposure of a substrate held on said substrate table, and said predetermined spatial frequency is substantially equal to 1 divided by 30 the width of said projection beam in the scanning direction of the apparatus.
5. Apparatus according to claim 1, wherein said filter is adapted to reduce cross-talk between rotation of said object about a parallel axis and parallel translations of said object.

6. Apparatus according to claim 1, further comprising a position sensor for detecting a position of said at least one of said support structure and said substrate table, an output of said position sensor being subtracted from an output of said level sensor to form said position signal; and wherein said servo system comprises an inner control loop including said position sensor for controlling the position of said at least one of said support structure and said substrate table, and said filtered position signal forms a setpoint for said inner control loop.

5

7. Apparatus according to claim 6, wherein said position sensor comprises an interferometric displacement measuring system or a Linear Variable Differential Transformer (LVDT) measuring system.

10

8. Apparatus according to claim 1, wherein at least one of said support structure and said substrate table are moveable to effect a scanning exposure of a substrate held on said substrate table, and said level sensor is arranged to measure at least one of the perpendicular position and the tilt about at least one parallel axis of a measurement point on said surface of said object ahead of the center of said projection beam in the scanning direction.

15

9. Apparatus according to claim 8 further comprising a position sensor for detecting a position of said at least one of said support structure and said substrate table, an output of said position sensor being subtracted from an output of said level sensor to form said position signal; and wherein said servo system comprises an inner control loop including said position sensor for controlling the position of said at least one of said support structure and said substrate table, and said filtered position signal forms a setpoint for said inner control loop,

20

25

wherein said position sensor is arranged to measure the position of said at least one of said support structure and said substrate table at a point corresponding to said measurement point of said level sensor.

10. Apparatus according to claim 8, wherein the distance of said measurement point ahead of said center of said projection beam is dependent on the speed of said scanning exposure.

30

11. Apparatus according to claim 8, wherein said filter has a transfer function that is dependent on the speed of said scanning exposure.

5 12. Apparatus according to claim 1, wherein said object is one of the patterning structure and the substrate held by one of the support structure and substrate table, respectively.

13. Apparatus according to claim 1, wherein the support structure comprises a mask table for holding a mask.

10

14. A method of manufacturing a device comprising:

providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

providing a projection beam of radiation;

15

patterning the projection beam to produce a pattern in its cross-section;

measuring at least one of a perpendicular position and tilt about at least one parallel axis of a surface of an object and generating a position signal indicative thereof, perpendicular referring to a direction substantially perpendicular to the said surface and parallel referring to a direction substantially parallel to said surface;

20

projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material while operating a servo system responsive to said position signal to maintain said object at said desired position; and

filtering said position signal before it is used by said servo system to control the position of said object.

25

15. A device manufactured according to the method of claim 14.

